8a. **R. triloba** L. var. **triloba** (*R. triloba* L. Sp. Pl. **2:** 907. 1753; *R. Beadlei* Small, Fl. S. E. U. S. ed. 1, 1258. 1903; *R. triloba* L. var. *Beadlei* (Small) Fern., RHODORA **39:** 458. 1937.).

8b. **R. triloba** L. var. **pinnatiloba** T. & G., Fl. N. Am. **2:** 309. 1842; (*R. triloba* L. β *pinnatiloba* T. & G., Fl. N. Am. **2:** 309. 1842; *R. pinnatiloba* (T. & G.) Beadle, Bot. Gaz. **25:** 277. 1898.).

8c. **R. triloba** L. var. **rupestris** (Chickering) Gray, Syn. Fl. N. Am. **1**(2): 260. 1884; (*R. rupestris* Chickering, Bot. Gaz. **6:** 188. 1881.).

9. **Rudbeckia graminifolia** (T. & G.) Boynt. & Beadle, Biltmore Bot. Stud. **1:** 12. 1901. (*Echinacea ? atrorubens* β *? graminifolia* T. & G., Fl. N. Am. **2:** 306. 1842; *R. atrorubens* of Gray, Syn. Fl. N. Am. **1**(2): 259. 1884, not Nutt.).—U. S. DEPARTMENT OF AGRICULTURE, AGRICULTURAL RESEARCH SERVICE, CROPS RESEARCH DIVISION, BELTSVILLE, MD.

PARAFORMALDEHYDE AS A SOURCE OF FORMALDEHYDE FOR USE IN BOTANICAL COLLECTING

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SINCE 1946 the author has been using the "formalin technique" for the preparation of botanical specimens under tropical conditions. Various modifications have been made to the technique employed since first used in New Guinea.

The method as now used requires the following materials in addition to the usual equipment of a botanist engaged in collecting in tropical forests:—

(1) Newspaper or newsprint, preferably cut by guillotine to 17½" x 11½" with the fold on one of the long sides.
(2) Latticed frames, 18" x 12", constructed of 1" x ¼" dressed timber, spaced 1" apart in the lattice and nailed at all points of contact between the horizontal and vertical members.
(3) An aqueous solution containing approximately 4% formaldehyde by weight.
(4) A rectangular tank with inside measurements 18½" x 12½" and of 12" depth.
(5) Strong waterproof paper with an inner core of bituminised fibre of the brand known as "Sisalkraft" in Australia.

When collecting in the field botanical specimens are placed individually between sheets of newsprint. Pads of newsprint containing 10 to 12 sheets with fold on the left enclosed in a single folded sheet with fold on the right provide a ready means of collecting the 10–12 duplicates of each species generally secured by the author. Each packet then represents the material collected of each number. These packets are placed between a pair of the 18″ x 12″ lattice forms which can be held together with straps or several turns of strong string. Considerable pressure can be exerted on the specimens in this way.

On return to the base camp after a day's collecting the bundles may be opened and the specimens repacked into new newspaper if desired. This is frequently necessary and is generally desirable as the specimens are "tamed" after this first pressing. Leaves, flowers and fruits may be arranged to best advantage from the point of view of the final specimen at this stage. Care should be taken when preparing this repacked bundle to use pads of folded newspaper to protect any parts of the specimen of considerable thickness, e.g. fruits, twigs etc. If done carefully the final bundle will be rectangular in shape.

The tank constructed from galvanised sheet iron and heavily painted internally with bituminous paint, is now approximately ⅓ filled with formalin containing 4% formaldehyde. These tanks which are fitted with a good lid and carrying handles make ideal transport boxes for the collecting frames, newspapers etc. The prepared bundles of specimens are then placed into the tanks, more formalin added if necessary to completely cover the bundle and a stone placed on top to ensure that the bundle of specimens remains submerged.

Specimens are left in the tanks for 18 to 24 hours, then removed, drained of free liquid and securely wrapped in "sisalkraft" waterproof paper. For transport by human porterage it is well to sew bundles into a large jute sack of the type used for shipping copra.

The bundles of specimens are then transferred to headquarters where drying facilities using artificial heat are available. Bundles of specimens treated by this technique have been kept for periods up to 3 months without deterioration.

The above technique largely follows that discussed by Schultes (1947), Fosberg (1947), and Lawrence (1951). The use of alcohol in a country such as New Guinea is not very practical in view of the strict legislation which restricts the access of the indigenous population to alcoholic liquors. However, Fosberg's claim that the alcohol increases the wetting properties of the solution may be readily met by the addition of an ounce or so of detergent to the formalin. The actual benefit of such an additive is doubtful except where the plant foliage has a decidedly waxy epidermis. Perhaps added detergent would be beneficial in handling succulents.

The use of the tanks allows the specimens to be handled with a minimum of inconvenience from the odour of formaldehyde. In any camp the tanks provide welcome seating space even when in use.

A considerable step forward in using formalin in the tropics is claimed by the success achieved using paraformaldehyde powder as a source of formaldehyde. Cartage of liquid is thereby obviated. Hitherto this has been the greatest problem in using formaldehyde in tropical countries; apart from the weight, glass containers are easily broken and tins tend to rust allowing leaks to occur which, if the material is being carried by air, as is frequently so, can cause great inconvenience.

Paraformaldehyde, obtainable commercially as a white powder in sealed tins of convenient weight, will dissolve slowly in cold water to form a solution of formaldehyde. Rate of solution is accelerated by stirring, increase of temperature or the presence of alkali. Under controlled laboratory conditions 20 grams of paraformaldehyde powder was dissolved in 250 mls. of rain water at 64°C in the presence of hexamine, 0.4% by weight, with intermittent shaking in 15 minutes to give a solution of specific gravity 1.023 when cooled to 28.2°C.

From published data and private communications the specific gravity of formalin is approximately equal to $1.00 + \frac{3W}{1000}$ where W is equivalent to the weight per cent of formaldehyde. To facilitate ascertaining the weight per cent of formaldehyde from specific gravity readings (conveniently taken with a clinical urinometer, range 1.000 to 1.050) an easily prepared graph is used.

In practice a bucket containing 2 gallons of water is heated almost to boiling point, about an ounce of hexamine added, removed from the fire and placed in a well ventilated place. The paraformaldehyde is added gently with continuous stirring. The operator should stand on the windward side during this operation. The solution will become clear in 5 to 10 minutes and may then be transferred to the tank to cool overnight. The specific gravity of the solution should be determined when cool and should not be less than 1.012. During use the specific gravity of the solution should be determined periodically and additional formaldehyde solution prepared and added as required.

In practice the use of formalin as a preservative allows the maximum amount of time in the field to be devoted to collecting. This is an important consideration when the collector is tied to a position which allows only limited time to be spent in the field. Certainly, if time permits, as in the major expeditions devoted only to biological collecting, specimens dried by artificial heat in the field are of excellent quality. Mention must be made of those collected by Mr. L. J. Brass of the Archbold Expeditions and Dr. R. D. Hoogland of the Commonwealth Scientific and Industrial Research Organization during field operations in New Guinea.

However, wherever time is limited the use of the formalin technique is strongly recommended. The quality of the final specimen is little impaired by comparison with the specimen dried directly. Certain advantages, namely inhibition of leaf fall and lack of blackening of the flowers of certain genera, e.g. *Mucuna* and some orchids accrue from the formalin technique. The yellow green colour of the finally dried specimen of aluminium accumulating plants, e.g. *Symplocos*, is retained. However, specimens prepared through the formalin technique are of doubtful value for investigation for pharmacologically active substances. Perhaps formalinized specimens should be so marked in herbaria.

An interesting possibility is the addition of an insecticide to the formaldehype solution which could obviate the use of mercuric chloride poisoning of the dried specimens. No experiments have yet been made but the author is giving consideration to a further improvement in the technique.

Grateful acknowledgement is made to Mr. L. J. Brass who first suggested to me the use of paraformaldehyde and who also furnished data supplied by Du Pont & Co. Inc., U.S.A., relating to the solubility of paraformaldehyde and the use of hexamine, to Mr. G. Hermon Slade of Polymer Corporation Pty. Ltd., Sydney; and to Mr. D. Murty, Senior Chemist, Department of Agriculture, Stock and Fisheries, Rabaul, for data on densities of formaldehyde solutions, and also to Mr. L. S. Smith and the late Mr. C. T. White who first introduced me to the use of formalin in the preparation of botanical specimens.

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NOTES ON SOME JAMAICAN EUGENIAS

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THE CLASSIFICATION of Jamaican rodwoods presents many unsolved problems. Volume 5 of "Flora of Jamaica" (1926) lists 14 species of *Calyptranthes* and 37 indigenous species of *Eugenia*. Many of these are still very poorly known, and at the same time new, undescribed species are occasionally being found. The identification of specimens is made more difficult by the fact that the key in "Flora of Jamaica" is not dichotomous. Aside from the mere troublesome mechanics of identification with a polychotomous key, one also begins to wonder if some of the taxa (especially those based on few or but a single collection) represent real populations. In some cases further collecting will perhaps show that certain taxa are not specifically distinct, while others will have their distinctness clarified by additional data.

One example of clarification involves two entities occurring in the northern part of the Parish of Clarendon and adjacent areas. These are *Eugenia confusa* and *Eugenia clarendonensis*.

Eugenia confusa is widely distributed in the West Indies and also occurs in southern Florida. *E. clarendonensis* has hitherto been known from a single locality called Peckham Woods, in northern Clarendon, Jamaica. The former species, which also occurs in localities adjacent to Peckham Woods, is usually distinguished by its larger, more narrowly acuminate leaves and "racemose-umbelliform" inflorescence. *E. clarendonensis*, on the other hand, is supposed to have strictly umbelliform axillary flower-clusters. In most other details these two taxa are suspiciously similar, as shown by the following table: